extremes are given. The scale of wind force is 0 to 10. Two directions of wind, or values of wind force, connected by a dash, indicate change from one to the other.

The rainfall for twenty-four hours is now given as measured at 1 p. m. Greenwich time on the respective dates.

The rain gauge, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 50 feet above sea level.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p.m. Greenwich time.									
				Temperature.		Means.		Wind.		Total rainfall.	Average cloudiness.	Sea-level pressures.	
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Maximum force.			Maximum.	Minimum.
	*	†	†			‡	‡		§				
1	30.03	74	66.5	80	73	63.7	66	nne.	5	0.04	5	30.10	30.03
2	30.04	74	67	80	74	63.7	65	ne.	6	0.08	4	30.08	29.97
3	29.99	74	67	80	73	63.5	64	nne.	6	0.00	3	30.08	29.98
4	29.98	75	68	80	74	64.7	67	ne.	5	0.00	4	30.04	29.94
5	29.98	74	67	81	74	62.7	63	ne.	6	0.01	5	30.03	29.95
6	29.93	75	68	79	73	63.2	65	nne.	4	0.01	7	30.03	29.91
7	29.93	73	67	78	72	64.5	66	ne.	4	0.01	10	29.98	29.89
8	29.96	73	67	82	71	64.7	65	ne.	3	0.08	4	30.02	29.92
9	29.97	72	68	79	70	64.2	69	nne.	6	0.51	5	30.01	29.92
01	29.94	74	68	80	68	64.0	68	ne.	4	0.10	5	30.01	29.92
11	29.90	70	67	80	71	64.7	70	ne.	3	0.01	5	29.97	29.89
12	29.90	66	65	80	70	64.2	77	nne.	3	0.00	2	29.95	29.85
13	29.91	70	68	80	65	65.7	75	nne.	3	0.21	3	29.95	29.87
14	29.92	74	68	79	69	67.0	76	nne.	3	0.11	6	29.96	29.87
15	29.96	75	70	80	70	67.7	73	ene.	4	0.01	5	29.97	29.88
16	29.97	74	69	78	74	67.5	76	ne.	5	0.06	6	30.02	29.93
17	29.95	74	68	79	71	65.5	69	ne.	4	0.01	4	30.01	29.92
18	29.93	71	67	80	71	64.5	71	ne.	4	0.03	5	29.98	29.90
19	29.91	73	67	79	70	64.0	69	ne.	4	0.01	8	29.96	29.89
20	29.89	72	68	77	71	66.0	75	n-e.	4	0.02	10	29.93	29.87
21	29.91	74	68	81	71	66.0	72	ne.	2	0.01	8	29.94	29.86
22	29.91	72	68	80	72	66.5	67	ne.	3	0.17	7	29.98	29.90
23	29.91	66	65	80	70	65.2	77	ne.	3	0.03	4	29.98	29.89
24	29.89	66	64.5	81	65	64.7	77	ne.	2	0.00	3	29.97	29.86
25	29.93	74	67.5	80	65	65.3	69	nne.	2	0.01	3	29.98	29.89
26	29.97	73	67	81	73	63.5	66	nne.	2	0.00	2	30.02	29.95
27	30.00	74	66	79	72	63.3	65	nne.	4	0.00	2	30.02	29.92
28	30.01	71	67	80	72	63.5	68	ne.	3	0.02	5	30.02	29.93
29	29.97	72	66.5	79	70	64.0	72	ne.	4	0.08	5	30.06	29.94
30	29.89	72	65.5	78	69	62.5	65	ne.	4	0.01	4	30.01	29.92
Sums.	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.64	.....	.....	.....
Means.	29.95	.....	.....	79.7	70.8	64.7	69.6	.....	‖	.....	¶	30.00	29.91
Departure.	0.00	.....	.....	+1.1	+1.1	.....	−6.0	.....	.....	−4.20	.....	.....	.....

Mean temperature for November (6+2+9)÷3=74.9°; normal is 73.8°. Mean pressure for November is 29.95; normal is 29.95.

*This pressure is as recorded at 1 p. m., Greenwich time. †These temperatures are observed at 6 a. m., local, or 4:30 p. m., Greenwich time. ‡These values are the means of (2+9+6)÷4. §Beaufort scale. ‖Mean for the daytime is 3.8. ¶The mean during daylight is 5.0, whose departure from normal is +0.5.

DECEMBER, 1898.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p.m. Greenwich time.									
				Temperature.		Means.		Wind.		Total rainfall.	Average cloudiness.	Sea-level pressures.	
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Maximum force.			Maximum.	Minimum.
	*	†	†			‡	‡		§				
1	29.91	72	65	80	71	62.3	66	ene.	4	0.00	3	29.95	29.86
2	29.96	72	65.5	79	71	64.0	69	ne.	3	0.02	4	29.99	29.92
3	29.96	73	67	79	71	64.7	71	nne.	3	0.00	6	30.01	29.94
4	29.93	73	67.5	79	72	64.5	69	ne.	2	0.00	6	30.02	29.93
5	29.87	68	64.5	78	72	63.0	72	ne.	3	0.00	10	29.98	29.88
6	29.81	72	69.5	80	66	67.5	85	sw.	1	0.16	4	29.91	29.80
7	29.78	71	69	77	67	69.3	90	wsw.	1	0.56	10	29.86	29.77
8	29.77	64	63	80	69	65.0	85	w.	1	0.02	9	29.84	29.74
9	29.80	66	60	79	63	58.7	68	w-n.	5	0.00	4	29.83	29.71
10	29.92	63	57	74	63	54.3	62	n.	4	0.00	3	29.96	29.86
11	29.93	66	62	78	59	60.0	72	sse.	2	0.00	5	29.98	29.89
12	29.97	64	63	78	62	63.7	80	wsw.	1	0.00	4	29.99	29.88
13	29.97	63	62	78	62	63.7	79	sw.	1	0.00	5	30.04	29.94
14	29.99	73	69	78	61	67.5	79	s.	1	0.13	5	30.01	29.91
15	30.08	70	64	80	69	64.0	79	sw.	3	0.17	4	30.08	30.00
16	30.08	69	60.5	76	67	57.8	63	nne.	5	0.00	2	30.14	30.04
17	29.99	62	60	76	63	59.0	68	nne.	4	0.00	1	30.09	29.99
18	29.96	69	64	76	60	60.3	66	nne.	3	0.00	1	30.05	29.95
19	29.94	67	65.5	77	68	64.3	74	ene.	3	0.01	3	30.01	29.91
20	29.90	64	63	78	64	65.0	80	ene.	3	0.00	5	29.99	29.86
21	29.86	63	62.5	80	63	64.3	85	sw.	2	0.55	6	29.96	29.86
22	29.83	63	62	78	62	62.5	81	w.	2	0.10	5	29.91	29.81
23	29.87	58	56	74	58	64.3	68	nnw.	2	0.00	0	29.91	29.84
24	29.88	67	61	75	57	65.0	61	nnw.	3	0.02	2	29.95	29.85
25	29.86	69	65	74	64	60.0	70	n.	2	0.15	3	29.92	29.85
26	29.91	64	63	76	64	63.3	83	nne.	2	0.13	5	29.92	29.82
27	29.94	63	62	77	62	63.0	81	nne.	1	0.00	1	29.98	29.91
28	29.99	64	63	78	61	64.7	80	e.	1	0.00	5	30.04	29.95
29	29.95	71	63	79	62	62.5	67	ene.	3	0.00	6	30.03	29.95
30	29.92	65	63.5	77	70	63.5	72	ene.	2	0.01	6	30.02	29.94
31	29.94	66	65	79	64	64.5	78	s.	2	0.00	2	29.98	29.88
Sums.	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.03	.....	.....	.....
Means.	29.92	.....	.....	77.6	64.7	62.5	74.2	.....	‖	....	¶	29.98	29.88

Mean temperature for December (6+2+9)÷3=70.6°; normal is 71.6°. Mean pressure for December is 29.92; normal is 29.95.

*This pressure is as recorded at 1 p. m., Greenwich time. †These temperatures are observed at 6 a. m., local, or 4:30 p. m., Greenwich time. ‡These values are the means of (2+9+6)÷4. §Beaufort scale. ‖Mean for the daytime is 2.4. ¶The mean during daylight is 4.5.

CLIMATE AND CROPS IN NORTH CAROLINA.

By C. F. von HERRMANN, Section Director.

[NOTE.—The remarks of the Editor of the MONTHLY WEATHER REVIEW for October, 1898, page 470, alluding to the difficulty of locating the especial climatic influence that may have produced a good or a poor crop in any specific year, has suggested to Mr. von Herrmann the following brief study into the general relations between the weather of any season and the resulting crop in North Carolina. The results attained by him show that unseasonably cold weather and hot weather are equally liable to be deleterious. If, then, we add frosts, droughts, floods, and gales, we have at least six purely meteorological obstacles to success, and if we add the insects and the parasitic vegetable growths, we begin to realize the difficulties against which the farmer has to contend. And yet, after all, the plant will perfect its fruit and seed if it is in any way possible. In general, the skilful agriculturist helps the plant in many ways known to him, so that the resulting harvest is largely the result of man's ingenuity and only partially the result of climatic influences.—ED.]

CLIMATE AND CROPS IN NORTH CAROLINA, 1889 TO 1898.

The close of the crop season of 1898 completes a period of ten years during which the complex relationship between climate and the growth of crops has been studied in some detail in North Carolina, and gives opportunity for a brief résumé of the entire decade. Notwithstanding the remarkable variety in the influence exerted by climatic factors and the great difficulty of ascertaining under just what conditions crops flourish best, certain general facts stand forth clearly, and are perhaps worthy of note. It is remarkable, for instance, that the best average crop season experienced in North Carolina was that of the year 1890, following the extraordinarily warm winter of 1889–90; and that the next best season, that of 1894, also followed a relatively mild winter. It is true that the yields of small grains, especially wheat, were poor, and that in 1894 the fruit crop was frost-killed, yet the general excellence of other crops in quantity and quality was marked. In general the past ten years have been characterized by a gradual decrease in the amount of precipitation received up to the middle of the year 1898.

The climatic conditions prevailing during January, February, and March, before the real commencement of growth are important. The favorable conditions are comparatively dry weather, permitting uninterrupted work in the fields, and deficiencies in temperature. It is impossible to separate climatic agencies entirely from the other physical means employed to improve growth; deliberate and thorough preparation of the soil for planting and subsequent active cultivation of the growing crops are the most effective weapons the farmer possesses against adverse climatic influences. Unfortunately he is not always able, however willing he may be, to employ them. The spring of 1895 was in this respect the most unfavorable on account of the very cold, wet weather in spring, which delayed plowing and planting to such an extent that by the end of May crops were from three to four weeks late as compared with an average season. Similar conditions prevailed in the early part of the year 1892. On the other hand, the warm, dry weather of April and May, 1896, permitted such thorough preparation and development that subsequent injurious conditions had a minimum effect.

For good crops it is imperative that March be a cold month. Abnormally warm weather during March forces vegetable growth, and especially the blooming of fruit trees, and great damage invariably results from subsequent killing frosts which always occur in April. This phenomenon has occurred very frequently of late years, especially in 1894, 1897, and 1898. While other seasons have been more favorable in this respect, more or less fruit is always frost-killed in North Carolina in

spring, seeming to indicate that climatic conditions are unfavorable here for raising fruit, except in the western mountainous portions. By far the most advantageous climatic influences are deficiencies in temperature and excess of precipitation during April and May. If the ground during these months is cold and wet, germination and growth are delayed, and become slow and irregular, the difficulty of securing good stands is increased, and notwithstanding occasional remarkable recuperative power of vegetation, as shown for example, in July and August, 1895, the final results following any wet, cold April or May will be unsatisfactory. During the remainder of such years crops seem to be especially susceptible to unfavorable influences. April and May of both 1895 and 1897 were very unfortunate, and May, 1891, particularly so, with frost as late as May 8 heavy enough to kill corn and cotton.

In North Carolina the heaviest precipitation usually occurs in July and August. The experience of the past few years seems to show that the average rainfall for the State is in excess of the real requirements of crops. Moisture is important at this time of the year for cotton, which also can not withstand any considerable deficiency in temperature during July. The mean temperature for July, 1891, was the lowest experienced since 1872, and the cotton crop, which had already suffered from cold weather in May was seriously injured, and was practically ruined by subsequent excessive precipitation in August. Excessive precipitation causes rank growth of all crops and delays formation of fruit and its maturity, and also favors the growth of fungus diseases, as was the case notably in 1898.

Departures from normal temperature and precipitation in North Carolina.

(First column, temperature departures; second column, precipitation departures.)

	1889.		1890.		1891.		1892.		1893.	
January	+ 2.9	+0.91	+10.2	−2.94	+1.3	+0.31	−2.2	+1.70	−10.1	−1.44
February	− 4.0	−0.49	+ 8.0	−0.01	+5.1	+1.49	−0.4	−0.86	+ 0.1	+1.20
March	− 0.3	−1.67	− 0.5	−1.16	−3.1	+3.14	−3.4	−1.26	− 1.1	−2.25
April	+ 0.6	−0.14	+ 0.2	−1.02	+1.0	−1.40	−2.2	+0.21	+ 2.1	−1.24
May	+ 1.4	+0.41	+ 0.6	+0.58	−2.8	+1.17	−0.1	−0.64	− 1.8	+1.36
June	− 0.9	+1.54	+ 3.3	−1.54	+0.8	−0.68	+1.2	+2.31	− 1.3	+1.37
July	− 0.5	+2.15	− 1.4	+1.61	−3.4	+1.07	−1.6	+0.15	+ 0.8	−1.57
August	− 2.3	−0.23	− 1.8	+0.58	+0.3	+2.45	+1.4	−1.94	− 1.1	+1.35
September	− 2.0	−0.38	+ 0.8	+0.91	+0.7	−2.31	−1.8	− 0.94	− 0.4	+1.19
October	− 2.3	−1.09	− 0.3	+0.67	−3.5	−1.02	−1.3	−2.98	− 0.2	+1.94
November	+ 2.0	+0.99	+ 2.8	−2.97	−2.7	−0.25	−2.7	+0.34	− 1.4	−0.55
December	+10.3	−3.14	− 1.5	−0.14	+3.3	−1.39	−3.1	−0.92	+ 1.5	−0.60
Year	+ 0.4	−1.14	+ 1.7	−5 38	−0.3	+2.68	−1.4	−4.83	− 1.1	+0.79

	1894.		1895.		1896.		1897.		1898.	
January	+3.4	−0.44	− 1.4	+2.06	−1.6	−1.56	−2.9	−2.05	+4.0	−1.72
February	+0.2	+0.61	−11.5	−1.79	−0.8	+1.43	+1.5	+1.69	−3.6	−3.18
March	+5.8	−2.51	− 0.4	+0.71	−1.3	−1.97	+3.4	+1.00	+5.9	−0.54
April	−1.2	−3.02	− 1.6	−3.58	+3.8	−1.78	−0.9	−0.09	−4.4	−0.07
May	+1.0	−0.21	− 2.8	+0.62	+5.3	+0.07	−2.3	−0.48	+1.6	−0.52
June	+0.1	−1.75	+ 0.2	−0.84	−1.2	+0.99	+0.5	−0.38	+0.5	−0.96
July	−1.4	+0.49	− 1.4	−0.33	−0.2	+2.61	−0.4	+0.02	+0.1	+1.40
August	−1.0	+0.35	+ 0.5	−0.28	+0.9	−3.47	−0.7	−2.37	+1.4	+2.16
September	+1.8	+0.35	+ 3.8	−3.17	−0.1	+0.89	+0.3	−2.95	+1.9	−0.18
October	+0.3	+1.93	− 3.7	−2.56	−2.0	−1 67	+2.7	+0.42	+0.8	+2.85
November	−1.0	−1.90	+ 1.0	−0.17	+5.0	+1.35	+1.5	−0.43	−2.6	−0.08
December	+0.6	−0.20	− 0.2	−0.32	−2.0	−1.22	+1.3	−0.06	−0.5	−0.99
Year	+0.6	−5.30	− 1.6	−1.64	+0.6	−4.33	+0.3	−5.68	+0.4	−1.83

After August adverse conditions, excepting such as result in local loss from heavy rains, floods, or windstorms, have little influence on the ultimate yield of crops. However, early frosts sometimes seriously injure cotton and tobacco. The coldest fall experienced was that of 1892, during which deficiencies in temperature occurred continuously from September to December, with early frost damaging cotton. Both 1896 and 1897 were notable for probably the most severe drought experienced in North Carolina, during the fall, with apparently great deterioration in the condition of crops, yet the final yields were by no means as small as anticipated.

Damage by local storms is comparatively rare. A few instances may he noted: Damage by hail was considerable during May, June, and July, 1891, and in May, 1898. The hurricane of August, 1893, damaged crops throughout the State about 20 per cent by floods and winds.

THE SAN DIEGO WATERSPOUT.

By FORD A. CARPENTER, Weather Bureau.

The weather map on the morning of December 9, 1898, presented the unusual spectacle of an area of high pressure with a crest exceeding 31.1 inches at Denver. Although this high was 600 miles northeast of San Diego, its abnormal intensity was probably responsible for as severe a local storm as this station has ever experienced. The principal feature was a waterspout accompanied by thunder and lightning, which bore a close resemblence to one of the dreaded *chubascos* which rarely occurs north of latitude 18°.

The first instrumental indication was at midnight, when the barometer fell steadily. This was accompanied by a consequent increase in temperature, the thermograph showing an easy upward curve until 2:30 a. m. (local time), when it registered 58°, the maximum for the day. The wind was blowing with gradually increasing velocity from the southeast, south, and southwest, from which last direction a maximum velocity of 23 miles was recorded.

On the evening of December 8, the western sky presented an unusual and beautiful sight. Countless cumulus clouds with well-defined bases, towering tops, and uniform size extended over the southwestern sea as far as the eye could reach. This extravagant display of clouds culminated at 2:30 a. m. in a succession of thunderstorms lasting until nearly sunset. This was the first thunder heard since August 20, 1897. The first shock was unusually loud, rattling the windows and awakening sound sleepers. Rain fell almost immediately to the amount of 0.43, ending at 4.40 a. m. The temperature suddenly dropped 8°, and the barometer rose. The wind shifted to all points of the compass, but with low velocity, settling into a northeast breeze of 20 miles, from which direction a few hours later, it slowly veered to the southeast, attaining a maximum velocity of 35 miles at 9:50 a. m.

It was just before this maximum of 35 miles per hour (the highest velocity of the year), that the waterspout was observed about 8 miles distant a little north of west from the Weather Bureau office, or 2 miles off Point Loma. A gray mass of nimbus cloud overhung the moderate swell of the sea, and from this cloud a convex projection first appeared, rapidly changing its form in an erratic manner, but quickly terminating in a slightly inclined column of whitish vapor. It was about 1,000 feet in height and probably averaged one-tenth that amount in diameter. The location and dimensions of the waterspout were ascertained by considering the observations of several persons located at different elevations and portions of the city, and taking into consideration the known height of the promontory of Point Loma.

For ten minutes this sheath of condensed vapor moved in a northeasterly direction toward the shore with a velocity of about 20 miles an hour, when it apparently dissolved into the black mass of nimbus cloud which, throughout the existence of the waterspout, had served for a background. Shortly after it disappeared, rain fell in torrents on the low hills closely skirting the shore line. At La Jolla, 12 miles north of this station, 3 inches of rain fell in a few hours. The recently plowed grainfields in this locality looked as if tanks of water had been emptied in various spots. Several culverts on the railroads near this place were washed away.

During the night the fishing fleet put into the harbor, and as the other coastwise craft were detained by the gale, the